(typical temperature environment of 240 K) be liquefied at a rate of 12.6 grams per hour (g/hr) and stored at a pressure of 0.2 atmospheres (atm) (0.2 megapascals (MPa)).

Figure 1 shows a schematic of the test setup. Using nitrogen as a surrogate test gas (for safety reasons), N_2 gas at room temperature was supplied to a liquefier in an environmental chamber nominally maintained at 240 K. System pressure was 2 atm (0.2 MPa). An average liquefaction rate of 9.1 g/hr of nitrogen was realized over a 3.55-hour period. The equivalent oxygen liquefaction rate is obtained by considering both the increase in refrigeration capacity of the cooler at the higher oxygen liquefaction temperature and the ratio between the total enthalpy changes of oxygen and nitrogen when cooled from room temperature and liquefied. It follows that liquefying nitrogen at a rate of 9.1 g/hr corresponds to an oxygen liquefaction rate of 12.9 g/hr. This exceeds the planned demonstrations for the 2003 Mars mission goal by 2%.

The more formidable challenge remains to demonstrate that the 2,500 g/hr requirement for the later human missions can be met with an economically feasible package.

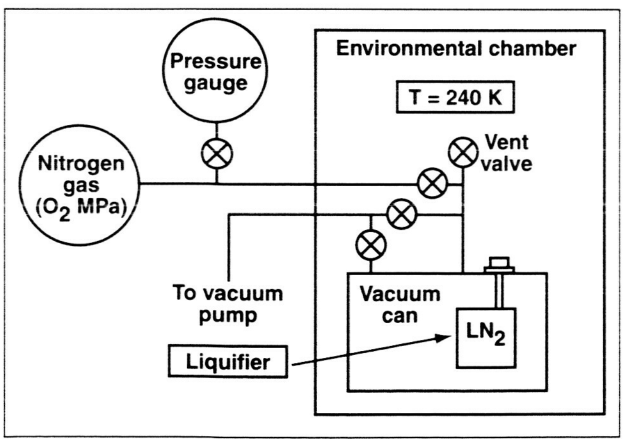

Fig. 1. Liquefier test setup.

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Integration of Pressure-Sensitive Paint Data to Obtain Loads

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A primary reason for developing pressure-sensitive paint (PSP) for wind tunnel testing has been the desire to use PSP in measuring aircraft loads. This would obviate the need for a separate loads model and test, as well as make loads data available much earlier in the design cycle than is presently the case. However, the ability of PSP to deliver accurate loads data cannot be validated until integrated pressures from PSP have been shown to give accurate force and moment values.

The main objective was to modify the current PSP data reduction code to support integration of pressure data over a model surface grid and to compare PSP-derived force and moment measurements with those obtained from the balance.

The current PSP data reduction code already produces pressure maps that are projected onto a model surface grid. This code was modified to produce integrated force and moment values by summing the mean pressure on each surface panel and multiplying it by the panel area. To verify the method, forces were computed from PSP data taken during a test of a semispan wing in the Ames Unitary Wind Tunnel in October 1993. Figure 1 shows a view of surface pressures on the wind tunnel model, together with the surface grid. This test was chosen because of the relatively simple model geometry, and because PSP data were available over the top and bottom of the wing.

The integrated PSP data are compared to balance data in figure 2, which shows lift coefficient computed using both methods. Values agree to within less than 3% except at the high positive and negative angles of attack. At these angles the model half-body, which was not coated with PSP and is thus not included in the pressure integration, begins to contribute substantially to the lift.

It remains to extend the pressure integration method to calculating moments, and to calculations for more complex aerodynamic shapes.

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